



# Global crises and equity market contagion

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Q-Group, Tampa, 2012



# Motivation

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- ◆ Return correlations increase in bad times
  - ◆ Bad shocks easily transmit across countries
    - Such shock spillovers often called “**contagion**”:
      - Connotation of “excessive” comovements
      - Historical examples: Tequila Crisis (1994-95), Asian Flu (1998), Russian virus (1998)



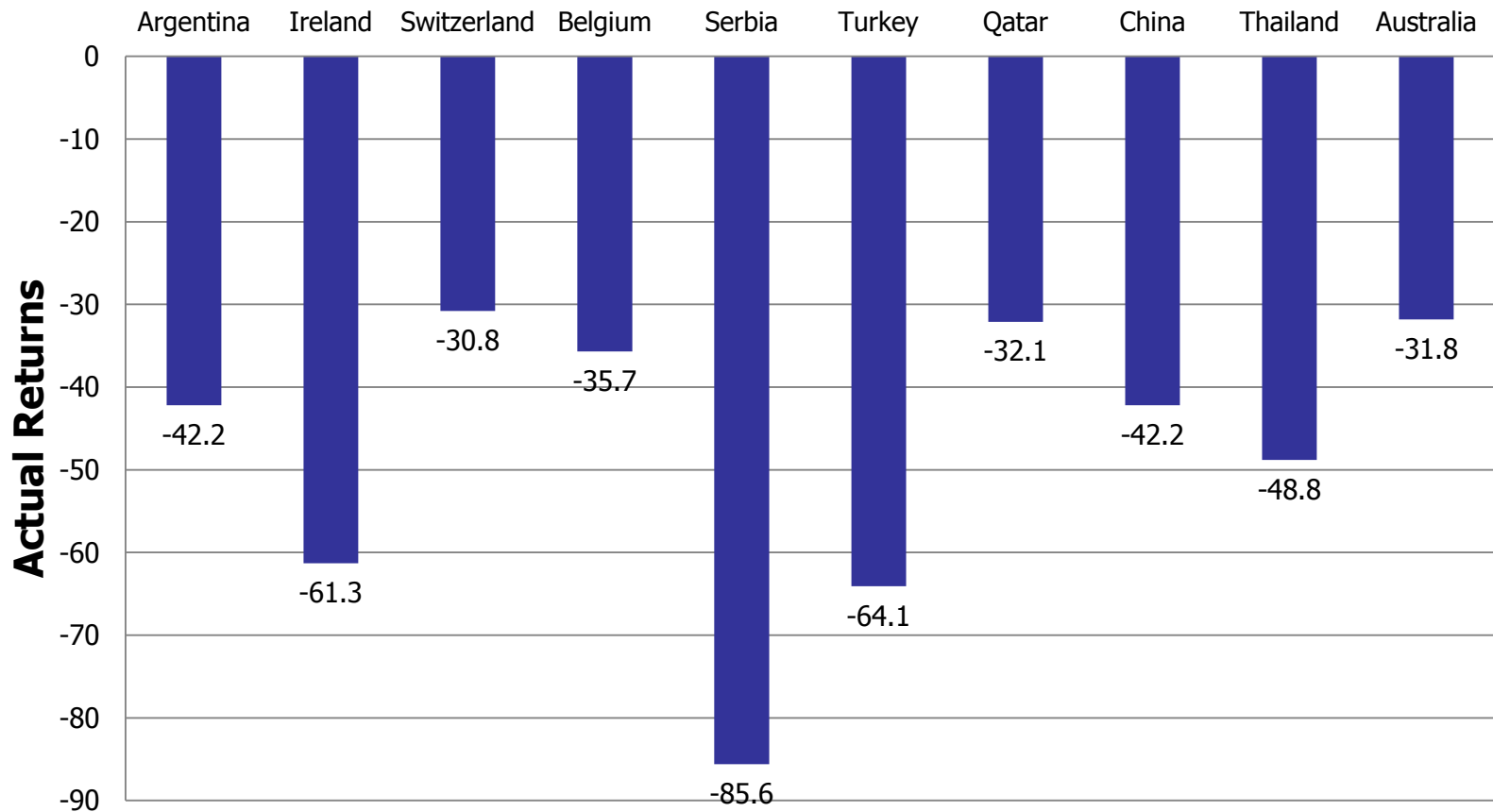
# Motivation

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- ◆ “There is no consensus on exactly what constitutes contagion or how it should be measured.”  
(see Forbes and Rigobon, 2001; Journal of Finance)
  - ◆ Revisit debate on:
    - Presence of contagion
    - Type/sources of contagion
  - ◆ An ideal lab: the global financial crisis of 2007/09



# Motivation

## ◆ Global Crisis August 7, 2007 – March 15, 2009





# Motivation

- ◆ Three popular hypotheses regarding contagion channels:
  1. “Globalization/interdependence”?  
*Economies integrated with US/global economy hit hardest (Forbes & Rigobon, 2002, etc.)*
  2. “Wake up call”?  
*Crisis initially provides new (fundamental) info to investors leading to generalized crisis (Goldstein, 1998; Masson, 1999, etc.)*
  3. Herd behavior?  
*Contagion without discrimination/unrelated to fundamentals (Boyer, Kumagai & Yuan, 2006, etc.)*



# Methodology

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- ◆ Contagion = excess correlation – that is, *correlation over and above what one would expect from economic fundamentals*. (see Bekaert, Harvey, Ng, 2005; Journal of Business)
- ◆ Any statements on contagion will be contingent on specification of a model that implies “normal correlations.”



# Methodology

## ◆ Volatility bias in correlations:

Let  $r_w$  = excess equity return on country  $i$

Let  $r_i$  = excess equity return on world market

$$\text{Let } r_i = \beta_i r_w + \varepsilon_i \quad \text{Then: } \rho_{i,w} = \beta_{i,w} \frac{\sigma_w}{\sigma_i}$$

global risk

country-specific risk

→ Increase in factor volatilities increases correlations ≠ contagion.

→ Unexpected increase in  $\beta$  = contagion



# Methodology

- ◆ World CAPM (one factor) model does not explain comovements
- ◆ Benchmark model with three factors:
  - U.S. factor ( $R_t^U$ )
  - Global financial factor ( $R_t^G$ )
  - Domestic factor ( $R_t^D$ )
- ◆ Factors orthogonalized; domestic factor excludes portfolio return under investigation





# Methodology

- ◆ In symbols:

$$R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,t}' F_t + \eta_{i,0} CR_t + e_{i,t} \quad (1)$$

$$\beta_{i,t} = \beta_{i,0} + \gamma_{i,0} CR_t \quad (2)$$

-  $CR_t$  = crisis dummy

- ◆  $\gamma_{i,0} > 0$ : contagion related to factors
- ◆  $\eta_{i,0} < 0$ : global contagion unrelated to factors
- ◆ Final model: time-varying determinants of factor exposures



# Main findings

## 1. US/global contagion limited

## 2. Domestic contagion stronger

- +50% beta increases; all economies/most sectors

## 3. 2007/9 financial crisis specific

- No domestic contagion in 1998 LTCM crisis and 2000/02 TMT bust

## 4. Not related to globalization/herd behavior

- External exposure (trade & financial integration) explain little; firm level characteristics and risk indicators do not either

## 5. Support for “wake-up” call hypothesis

- Poor country fundamentals (current account & fiscal positions, country ratings, etc. ) explain (domestic) contagion
- Financial policies (debt/deposit guarantees) reduce factor exposures



# Data

- 
- Stock prices from Bloomberg for 2000 firms
  - 55 countries, 10 sectors
  - 415 value-weighted portfolios
  - Excess returns (versus 3-month US T-bill rate)
  - Returns in US\$
  - January 1, 1995 – March 15, 2009, weekly data
  - Two crisis definitions, starting August 7, 2007 or September 15, 2008



# Empirical results

## Interdependence

- ◆ Can a constant beta model fit the crisis transmission?

$$R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,0}' F_t + e_{i,t} \quad (1)$$

- Three orthogonal factors:  $F_t = [R_t^U, R_t^G, R_t^D]'$
- Interdependence:  $\beta$
- Pooled OLS, standard errors clustered across countries



# Empirical results

## Interdependence

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	Benchmark	
	coef	<i>st.err.</i>
<b>Interdependence</b>		
$\beta_1^G$	0.406 ***	0.012
$\beta_1^U$	0.437 ***	0.015
$\beta_1^D$	0.540 ***	0.013

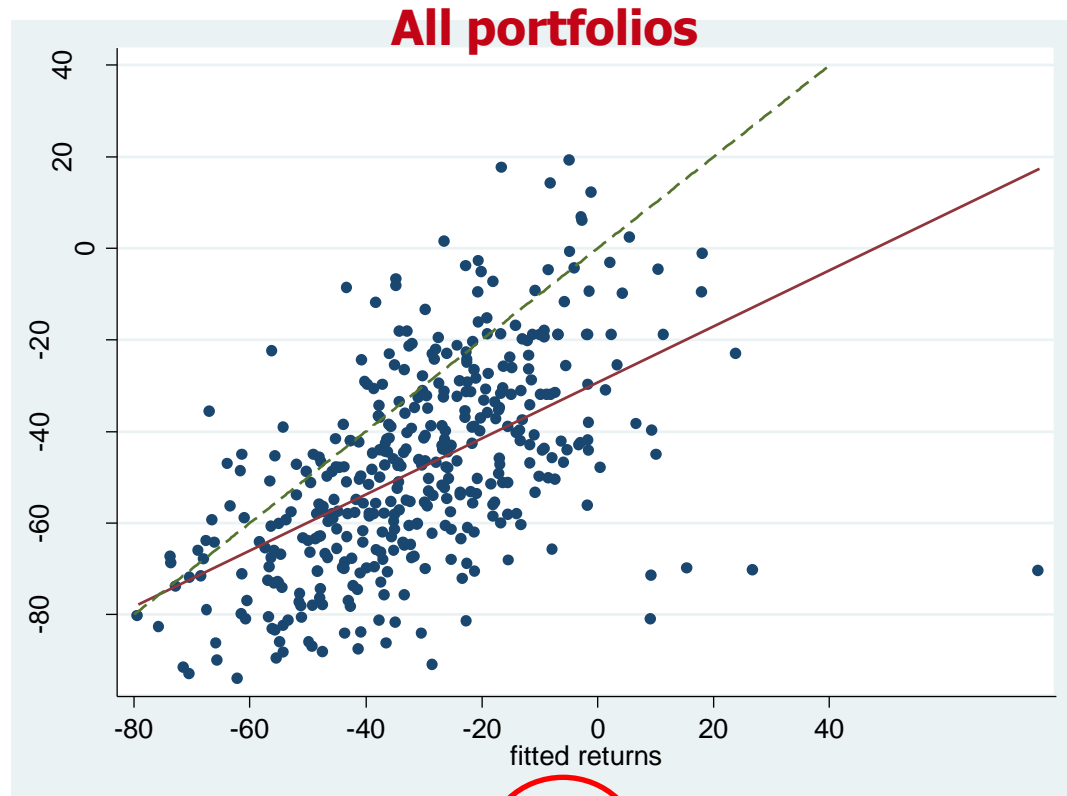
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- Equally weighted average of  $\beta_i$
- Clearly misspecified for crisis period (excess comovement of residuals at country level)



# Empirical Results

## Goodness of fit – Interdependence model



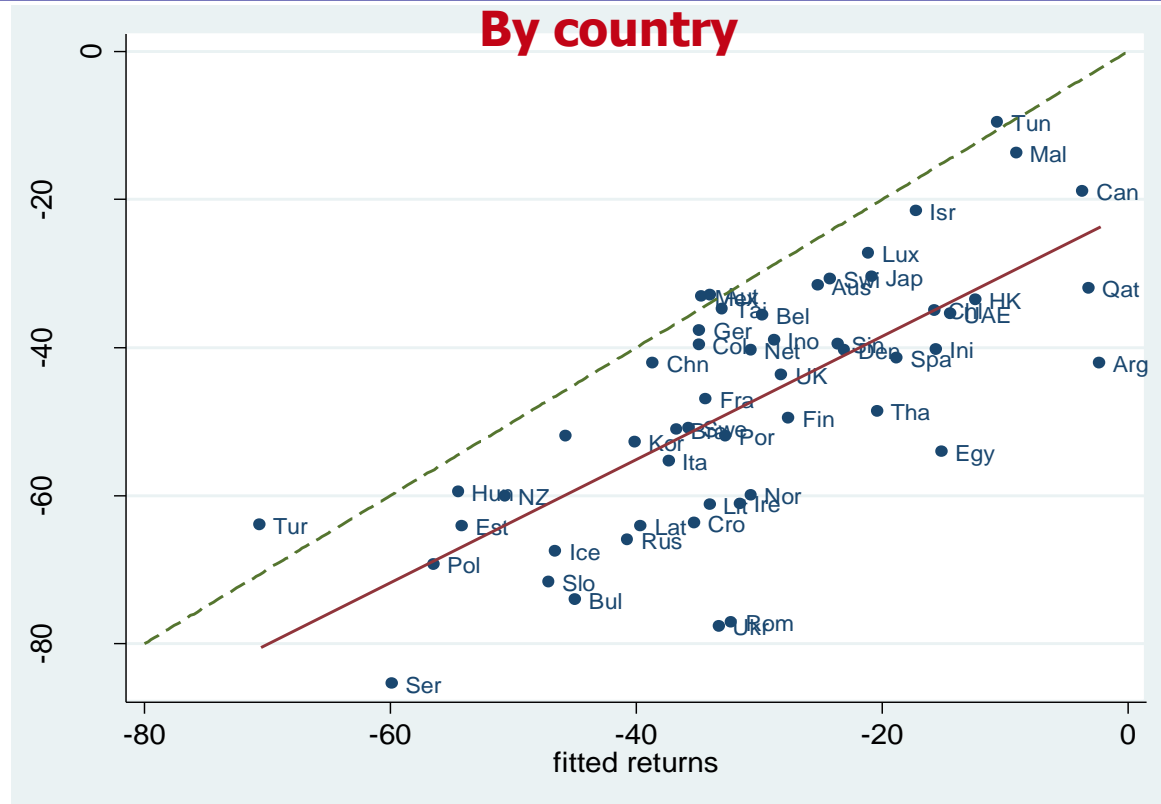
$$R_i = -7.037 + 0.489\hat{R}_i + \varepsilon_i, \text{ adj. } R^2 = 0.301$$

(2.444)      (0.046)



# Empirical Results

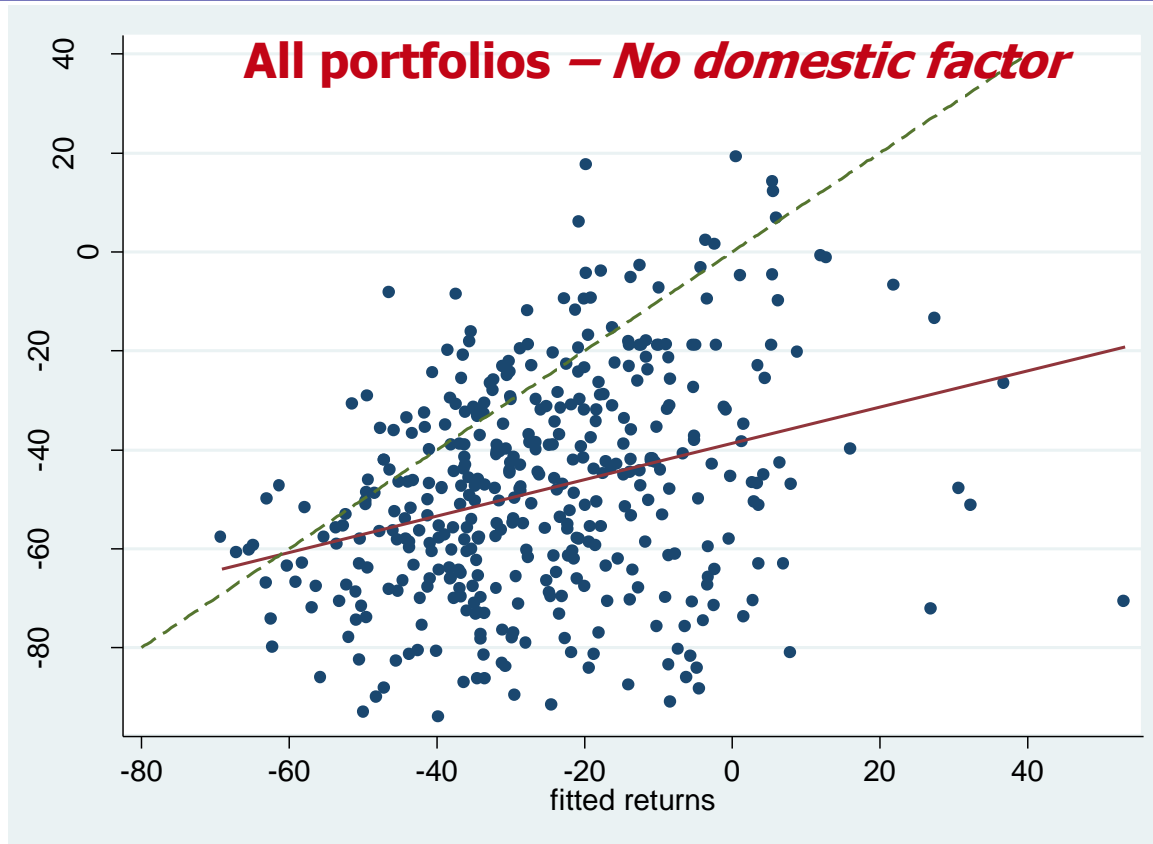
## Goodness of fit – Interdependence model



Underprediction of crisis severity...



# Empirical Results— The need for a domestic factor



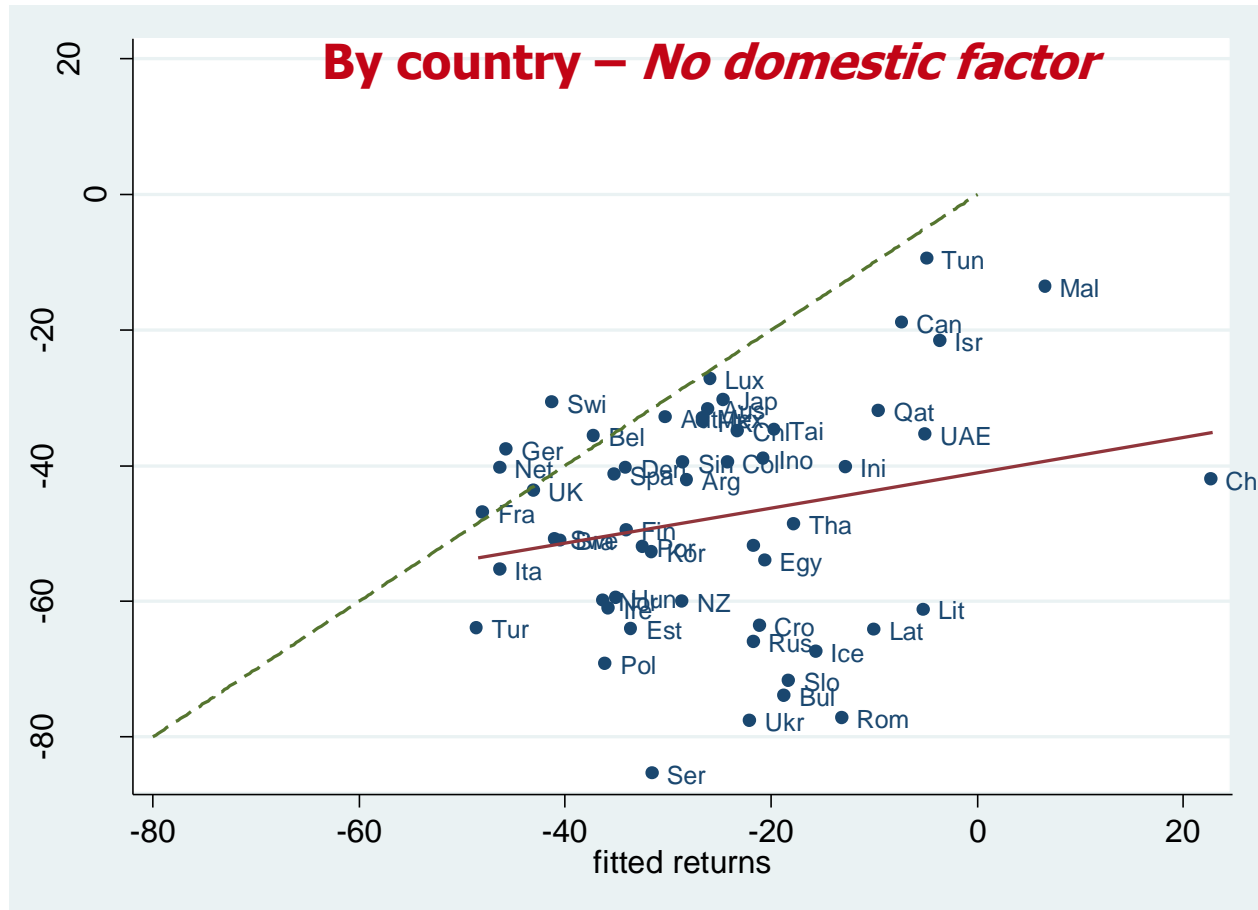
$$\hat{R}_i = -13.036 + 0.256\hat{R}_i + \varepsilon_i, \text{ adj. } R^2 = 0.094$$

(3.439) (0.058)





# Empirical Results— The need for a domestic factor





# Empirical results

## Contagion

- ◆ Was there contagion during the crisis?

$$R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,t}' F_t + \eta_{i,0} CR_t + e_{i,t} \quad (1)$$

$$\beta_{i,t} = \beta_{i,0} + \gamma_{i,0} CR_t \quad (2)$$

- Contagion:  $\gamma$ ; non-fundamental:  $\eta$
- $CR_t$  crisis dummy (start: August 7, 2007)



# Empirical results

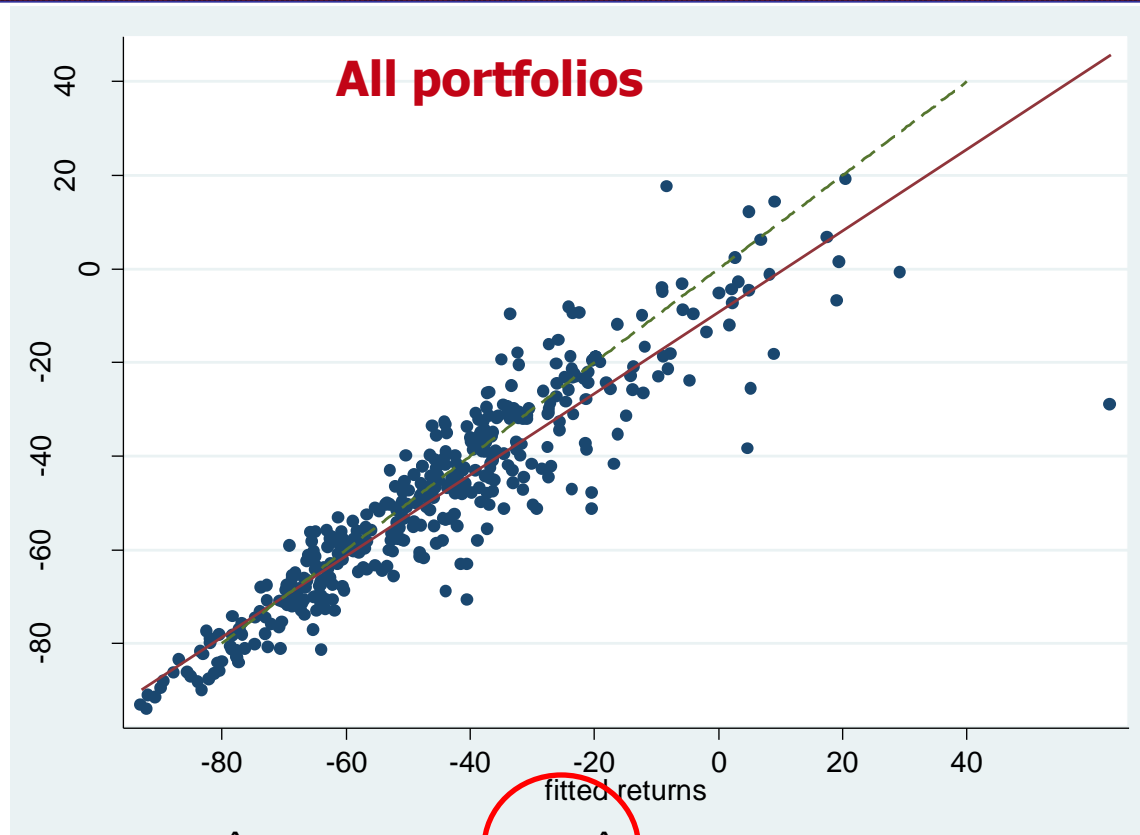
## Contagion

	Benchmark	
	coef	st.err.
<b>Contagion</b>		
$\gamma_1^G$	0.056 ***	0.013
$\gamma_1^U$	0.133 ***	0.015
$\gamma_1^D$	0.249 ***	0.016
<b>Interdependence</b>		
$\beta_1^G$	0.368 ***	0.012
$\beta_1^U$	0.397 ***	0.016
$\beta_1^D$	0.491 ***	0.014
<b>Other</b>		
$\eta_1$	-0.038	0.025



# Empirical Results

## Goodness of fit –Contagion model



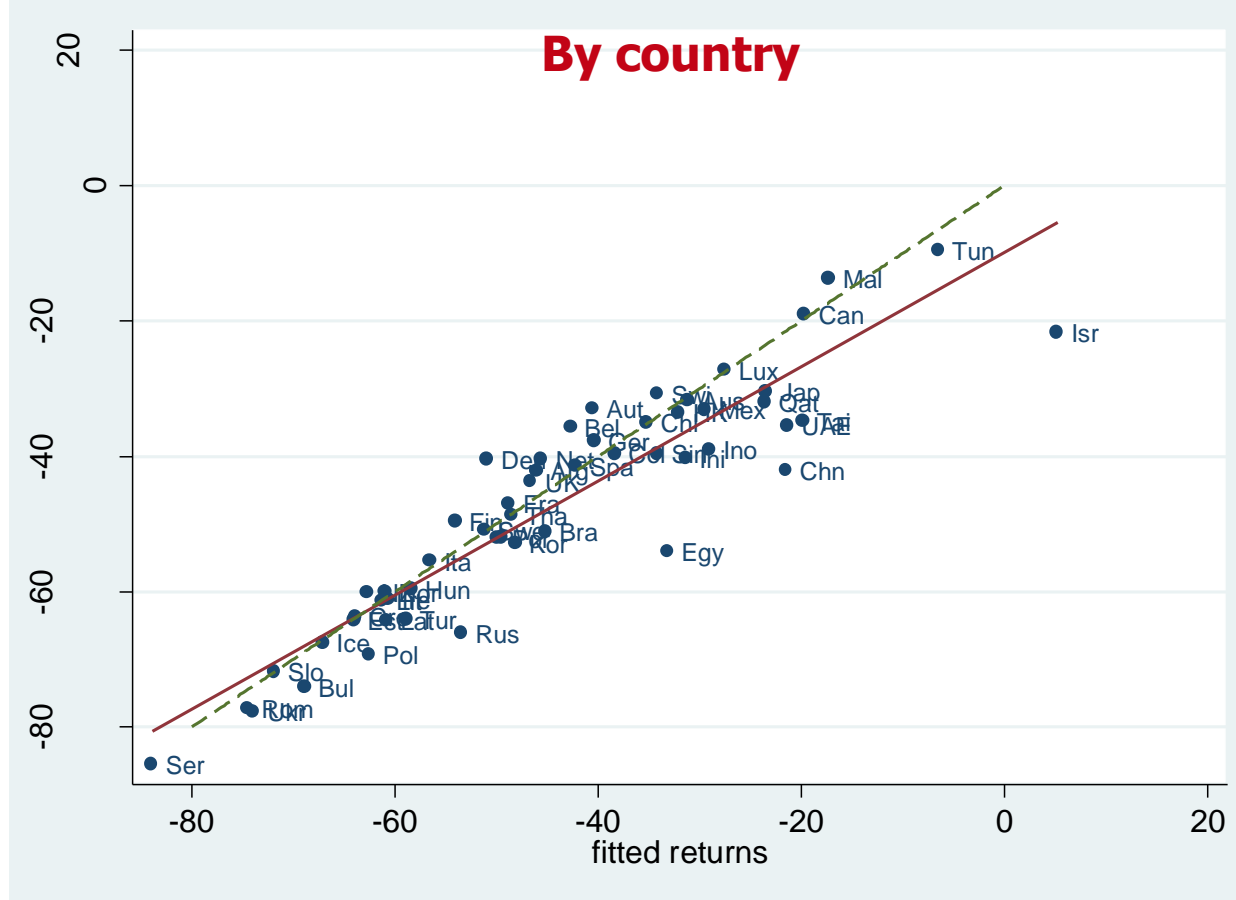
$$\hat{R}_i = 1.910 + 0.971\hat{R}_i + \varepsilon_i, \text{ adj. } R^2 = 0.843$$

(2.322) (0.033)



# Empirical Results

## Goodness of fit –Contagion model





# Empirical Results

## Goodness of fit –Contagion model

Increase in correlation during the crisis

	<b>Actual</b>	<b>Interdependence</b>	<b>Contagion</b>
U.S. Factor	0.171	0.159	0.170
Global Factor	0.197	0.228	0.220
Domestic Factor	0.082	-0.001	0.049



# Empirical Results

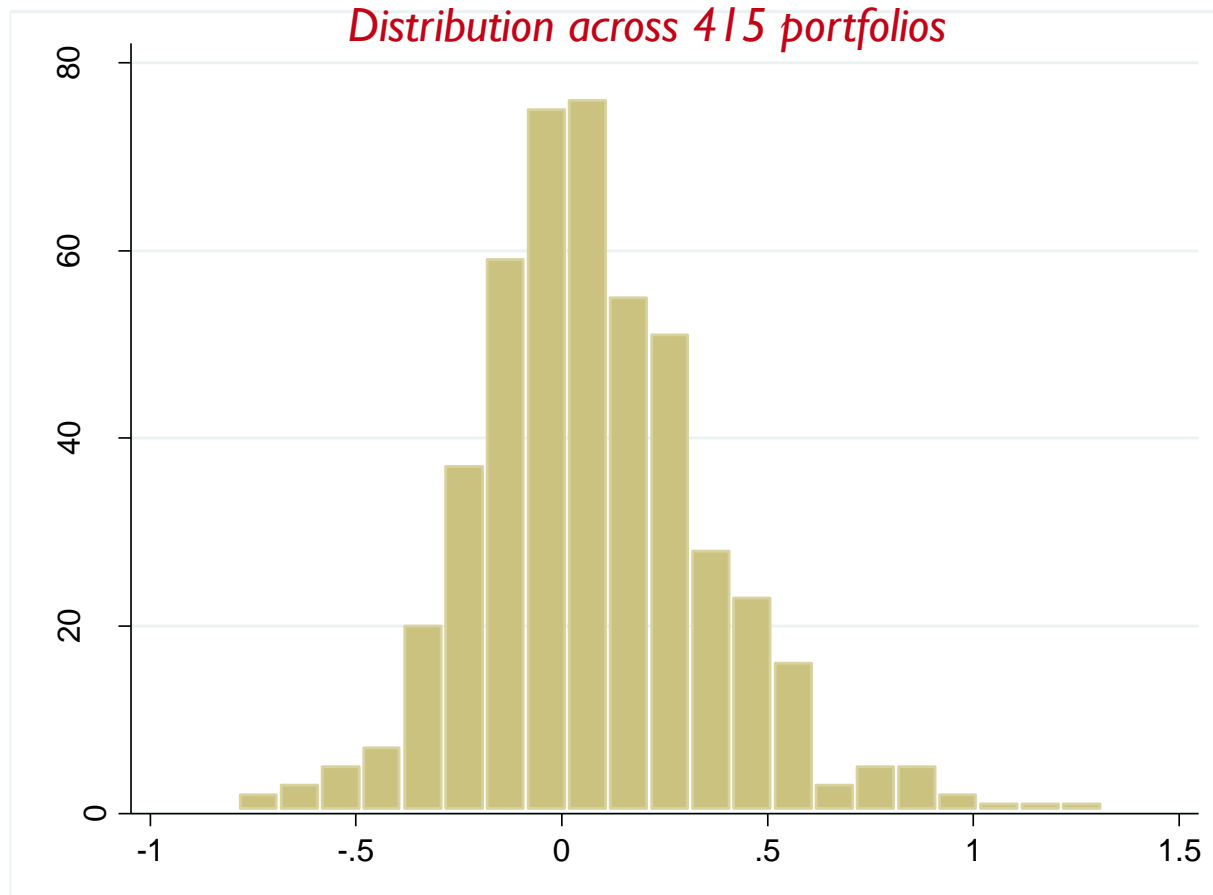
## Past global crises

	Benchmark		Post-Lehman		LTCM crisis		TMT bust	
	coef	st.err.	coef	st.err.	coef	st.err.	coef	st.err.
<b>Contagion</b>								
$\gamma_1^G$	0.056 ***	0.013	0.047 ***	0.014	-0.089 ***	0.019	0.010	0.013
$\gamma_1^U$	0.133 ***	0.015	0.142 ***	0.018	-0.026 ***	0.002	-0.004 *	0.002
$\gamma_1^D$	0.249 ***	0.016	0.283 ***	0.021	-0.030	0.030	-0.013	0.026
<b>Interdependence</b>								
$\beta_1^G$	0.368 ***	0.012	0.375 ***	0.012	0.381 ***	0.012	0.365 ***	0.012
$\beta_1^U$	0.397 ***	0.016	0.405 ***	0.016	0.403 ***	0.016	0.398 ***	0.016
$\beta_1^D$	0.491 ***	0.014	0.517 ***	0.014	0.495 ***	0.014	0.498 ***	0.014
<b>Other</b>								
$\eta_1$	-0.038	0.025	-0.148 ***	0.048	-0.179 ***	0.042	-0.032 *	0.018
Observations	322216		322216		185223		185223	
R-squared	0.310		0.348		0.310		0.310	



# Empirical Results

## Contagion from *US market* ( $\gamma$ )



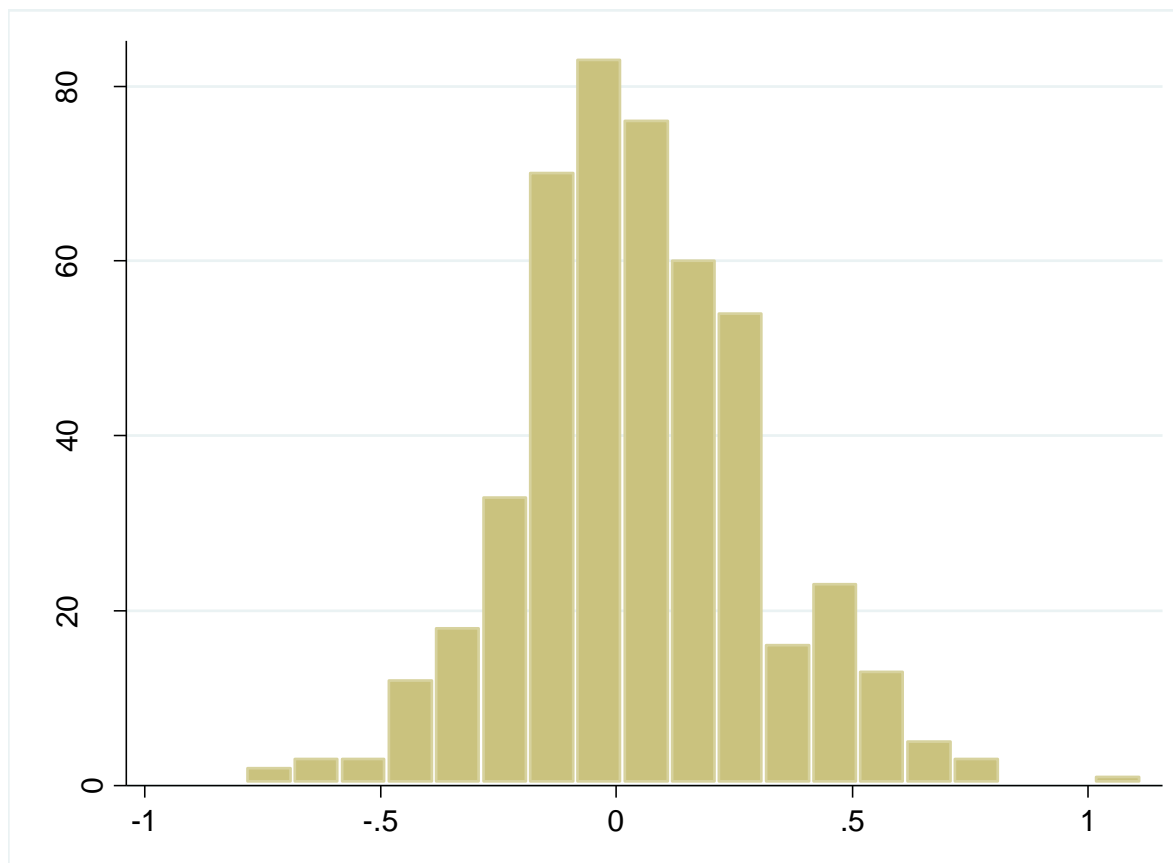




# Empirical Results

## Contagion from *global financial sector* ( $\gamma$ )

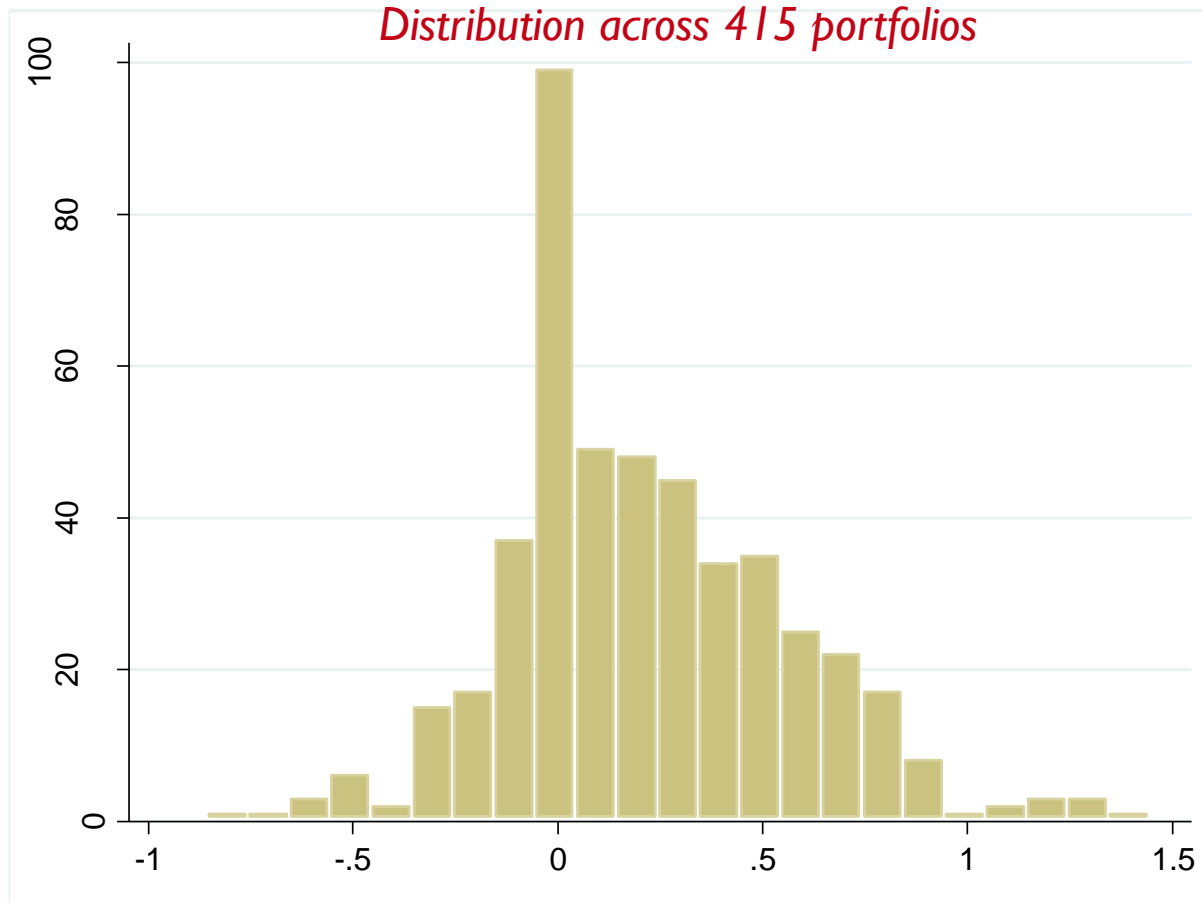
*Distribution across 415 portfolios*





# Empirical Results

## Contagion from *domestic market* ( $\gamma$ )

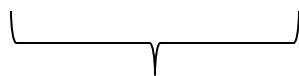




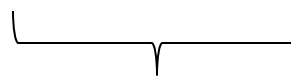
# Empirical Results

## Sector Contagion

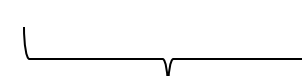
		Sector		
		Communications	Utilities	Financial
<b>Contagion</b>	$\gamma^G$	0.015	0.068	0.203***
	$\gamma^U$	-0.037	0.179***	0.106***
	$\gamma^D$	0.096	0.310***	0.194***
<b>Interdependence</b>	$\beta^G$	0.305***	0.286***	0.495***
	$\beta^U$	0.455***	0.236***	0.441***
	$\beta^D$	0.539***	0.394***	0.439***
<b>Other</b>	$\eta$	0.036	0.172***	-0.217***



Relatively  
unaffected



? defensive



Culprit sector



# Empirical Results

## Channels of Contagion

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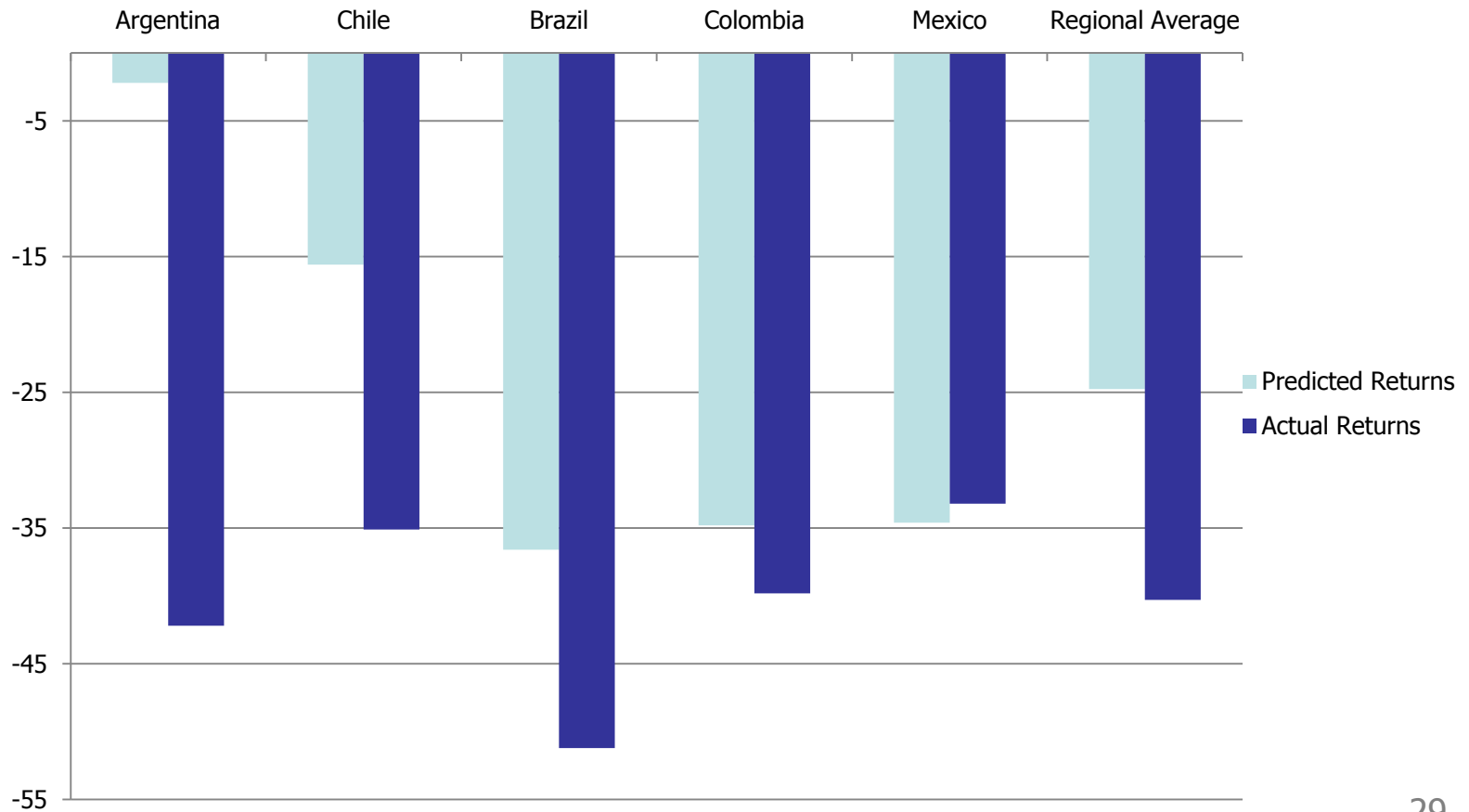
- ◆  $\gamma_i$  – coefficients are negatively correlated with  $\beta_i$  - coefficients:
  - Globalization hypothesis in doubt
- ◆  $\eta_i$  – small and statistically insignificant
  - Contagion captured by factor exposures
- ◆ What drives incidence of contagion? What drives domestic contagion?
  - Model cross-sectional/temporal variation in  $\beta$ 's;  $\gamma$ 's



# Empirical Results

## Channels of Contagion

### Latin America

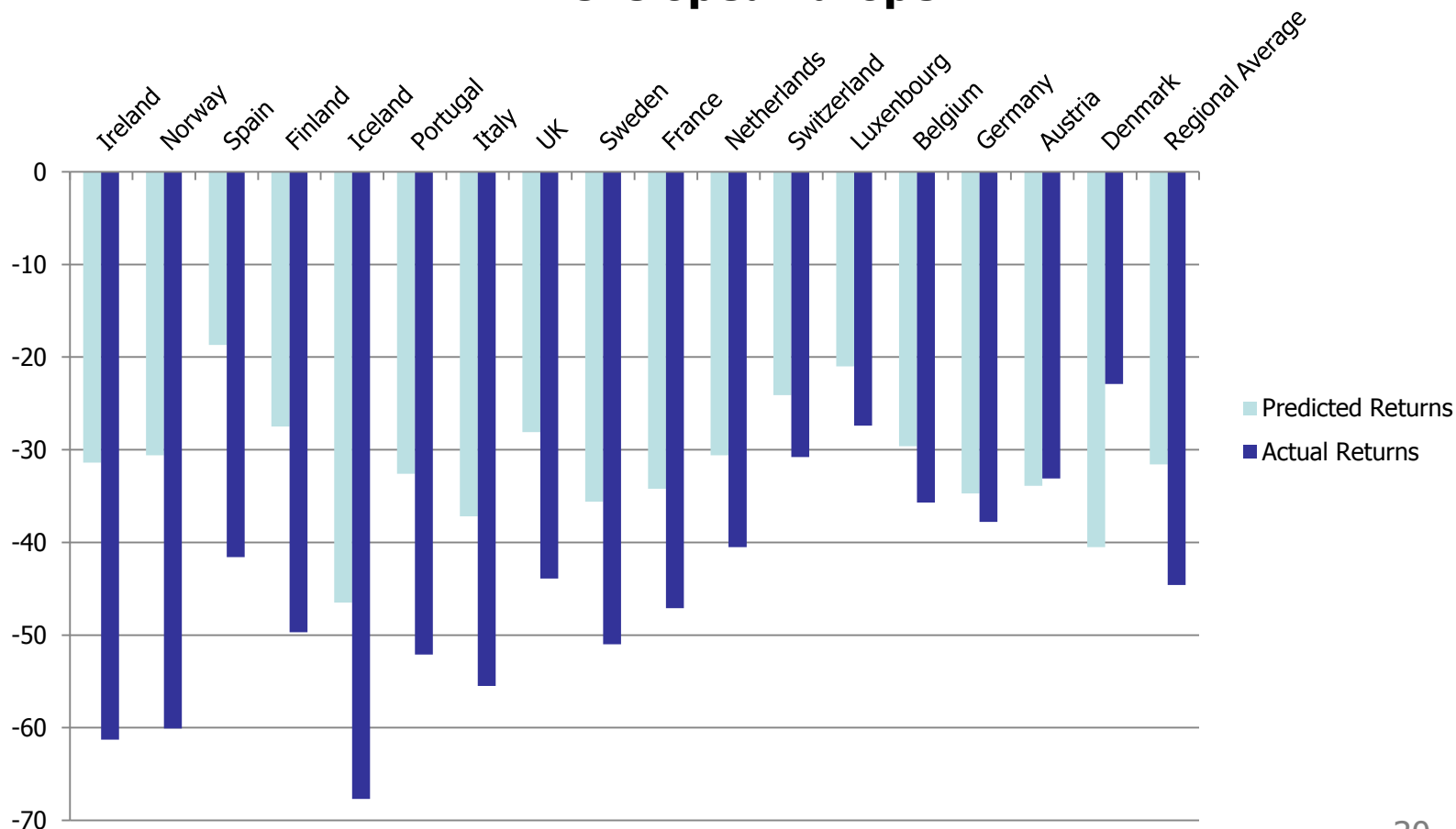




# Empirical Results

## Channels of Contagion

### Developed Europe

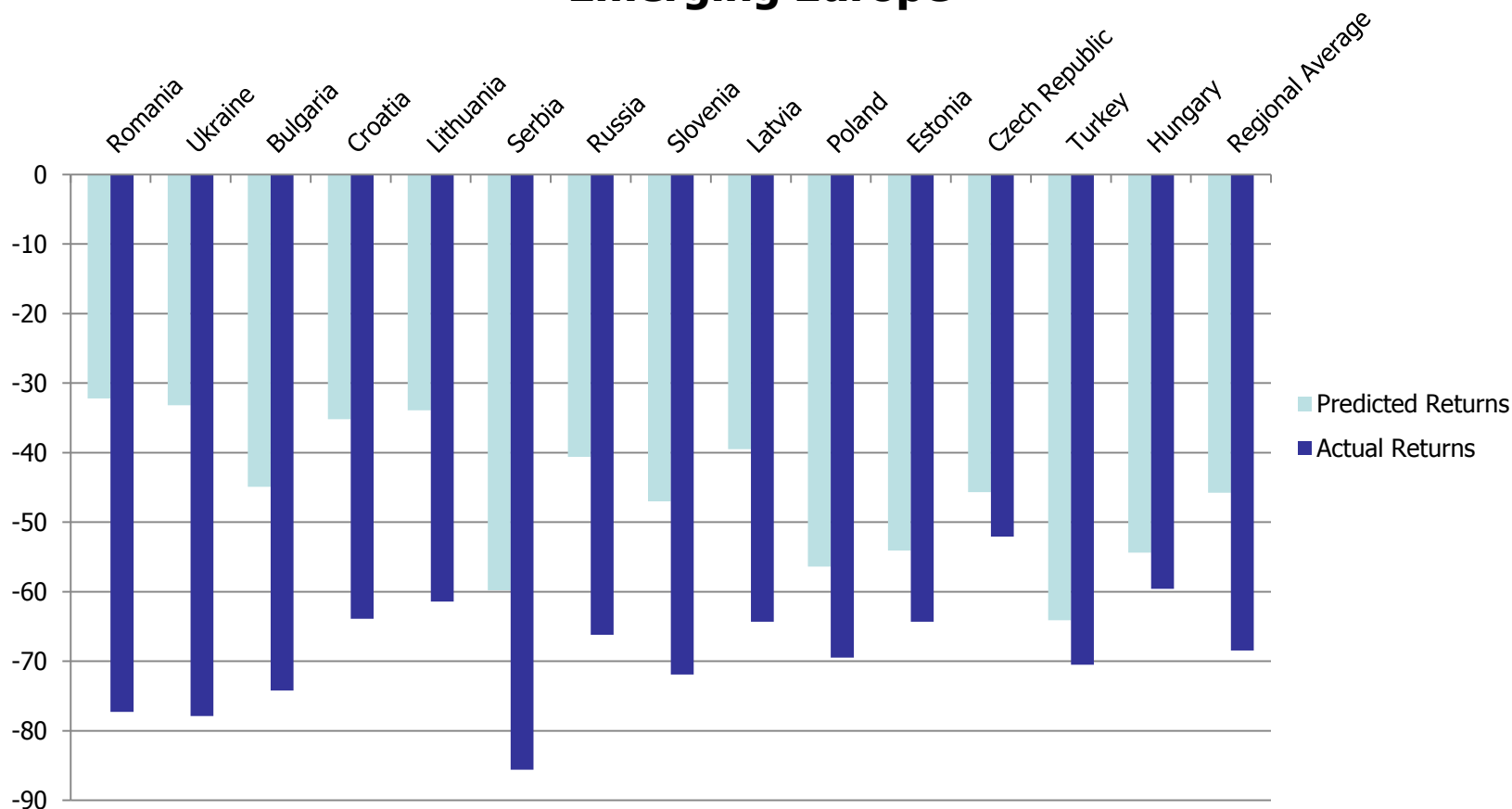




# Empirical Results

## Channels of Contagion

### Emerging Europe





# Empirical Results

## Channels of Contagion

$$\diamond R_{i,t} = E_{t-1}[R_{i,t}] + \beta_{i,t}' F_t + \eta_{i,t} CR_t + e_{i,t} \quad (1)$$

$$\beta_{i,t} = \beta_{i,0} + \beta_1' Z_{i,t-k} + \gamma_{i,t} CR_t \quad (2)$$

$$\gamma_{i,t} = \gamma_{i,0} + \gamma_1' Z_{i,t-k} \quad (3)$$

$$\eta_{i,t} = \eta_{i,0} + \eta_1' Z_{i,t-k} \quad (4)$$

- Determinants (lagged by 2 quarters):  $Z_{i,t}$
- Reduction of determinants in a general to specific procedure





# Empirical Results

## Channels of Contagion

- **External exposure/segmentation [H1: globalization]**
  - Portfolio investment flows; financial integration; financial depth; trade integration; exchange rate exposure
- **Domestic fundamentals [H2: wake-up call]**
  - Political stability; sovereign rating; FX reserves; current account position; unemployment rate, government budget balance
- *But also...*
- **Banking exposure**
  - Intra-bank exposures to US/RoW; credit growth; financing constraints, interest rate exposure
- **Financial policies**
  - Debt/deposit guarantees; capital injections
- **Information asymmetries**
  - Distance; telephone traffic; newspaper imports
- **Global/common risk and liquidity**
  - VIX, TED spread



# Empirical Results

## Channels of Contagion

	Contagion				Interdependence		
	US	Global	Domestic	Other	US	Global	Domestic
<b>Banking exposure</b>							
Bank exposure to ROW	-0.003 ***			-0.004 **	0.006 ***		
<b>Banking policy</b>							
Deposit guarantees			-0.118 **				
Debt guarantees		-0.145 ***	-0.163 ***	0.216 *			
Capital injections	-0.138 ***		-0.071 **				
<b>External exposure / segmentation:</b>							
Portfolio investment flows	-0.008 ***		0.007 ***		0.027 ***		0.007
Financial integration	-0.005 ***				0.003 ***		
<b>Domestic macroeconomic fundamentals:</b>							
Political stability/institutions		-0.015 ***	-0.029 ***	-0.055 ***		0.001	-0.013 ***
Sovereign rating		-0.017 *				0.011 ***	
Current account position	-0.006 ***			0.041 ***	0.014 **		
Unemployment rate	0.044 ***		0.018 **		-0.014 ***		0.002
Government budget	-0.002 **		-0.017 ***		0.028 ***		0.04 ***



# Empirical Results

## Channels of Contagion

	Contagion								Interdependence		
	Interquartile in crisis				Interquartile all				Interquartile all		
	US	Global	Dom.	Other	US	Global	Dom.	Other	US	Global	Dom.
<b>Banking exposure</b>											
Bank exposure to ROW	0.00			-0.02	0.00			-0.02	0.00		
<b>Banking policy</b>											
Deposit guarantees			-0.12					-0.12			
Debt guarantees		-0.14	-0.16	0.22		-0.14	-0.16	0.22			
Capital injections	-0.14		-0.07		-0.14		-0.07				
<b>External exposure / segmentation:</b>											
Portfolio investment flows	-0.03		0.02		-0.02		0.02		0.06		0.02
Financial integration	-0.17				-0.08				0.06		
<b>Domestic macroeconomic fundamentals:</b>											
Political stability/institutions		-0.06	-0.11	-0.22		-0.07	-0.14	-0.28		0.01	-0.06
Sovereign rating		-0.17				-0.17				0.11	
Current account position	-0.12			0.43	-0.06			0.37	0.15		
Unemployment rate	0.17		0.07		0.21		0.09		-0.07		0.01
Government budget	-0.02		-0.15		-0.02		-0.11		0.18		0.26



# Conclusions

- ◆ No indiscriminate spread of the crisis but “wake-up call”
- ◆ More contagion to portfolios in countries with weak fundamentals and poor policies
- ◆ Investors re-focused in the crisis on country characteristics and punished markets with poor fundamentals
- ◆ Debt and deposit guarantees instrumental in shielding domestic equity portfolios to some extent
- ◆ Ironically domestic factors regained importance in determining equity market performance in the most global crisis of recent times!



# Conclusions

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- ◆ World is still relatively “segmented” → domestic factors are critical
- ◆ Domestic factors become even more important determinants of risk exposures in the crisis
- ◆ Similar conclusions hold in valuation space, see Bekaert, Harvey, Lundblad and Siegel (2011)



# *Appendix*



# Severity of the 2007-09 financial crisis ...





# Data

*(55 countries, 10 sectors, 2000 firms, 415 portfolios)*

Country	Name of stock index	No. listed firms	Country	Name of stock index	No. listed firms
<b>Industrialised</b>			<b>Emerging Europe</b>		
Australia	S&P ASX	30	Bulgaria	SOFIX	20
Austria	ATX	20	Croatia	CROBEX	28
Belgium	BEL20	20	Czech Republic	PSE	14
Canada	S&P TSE 60	60	Estonia	OMX	18
Denmark	OMX20	20	Hungary	BSE	14
Finland	OMX25	25	Iceland	OMX ICEX	11
France	CAC 40	40	Latvia	OMX	35
Germany	DAX	30	Lithuania	OMX	32
Ireland	ISEQ	60	Norway	OBX	24
Italy	MIB 30	30	Poland	WIG 20	20
Japan	Topix 70	70	Romania	BET	10
Luxembourg	LuxX	9	Russia	MICEX	30
Netherlands	AEX	25	Serbia	Belex 15	15
Portugal	PSI 20	20	Turkey	ISE National 30	30
Slovenia	SBI20	15	Ukraine	PFTS	19
Spain	IBEX 35	35	<b>Middle-East and Africa</b>		
Sweden	OMX 30	30	Egypt	CASE	30
Switzerland	SMI 30	20	Israel	Tel Aviv-25	25
UK	Footsie 100	100	Lebanon	BLOM	19
<b>Asia-Pacific</b>			Tunisia	SE BVMT	32
China	Shanghai SE 50	50	UAE	DFM	29
Hong Kong	Hang Seng	42	<b>Latin America</b>		
India	BSE Sensex 30	30	Argentina	Merval	22
Indonesia	Jakarta LQ-45	45	Brazil	Bovespa	66
Korea	Kospi 50	50	Chile	IPSA	40
New Zealand	NZX 15	15	Colombia	IGBC General	28
Singapore	Strait Times	30	Mexico	Bolsa	36
Taiwan	TSEC Taiwan 50	50	Venezuela	IBC	17
Thailand	SET 50	50			





# Summary stats: Z instruments

Variables	Units	Frequency	Definition	Unit of observation	Source	mean	s.d.	min.	max.
<b>Banking exposure</b>									
Banking exposures to the US	% of GDP	Annual	Foreign claims (assets incl. deposits, loans, debt securities) of domestic banks vis-à-vis US banks, scaled by GDP	Country	BIS Consolidated statistics	1.71	1.11	0.01	11.81
Banking exposures to the rest of the world	% of GDP	Annual	Foreign claims (assets incl. deposits, loans, debt securities) of domestic banks vis-à-vis rest-of-the-world banks, scaled by GDP	Country	BIS Consolidated statistics	16.36	11.68	0.12	90.49
Credit growth	in %	Constant	Annual growth rate of credit to private sector	Country	IMF, Haver, Bloomberg	15.41	15.82	-55.70	98.80
Interest rate exposure	% of GDP	Constant	Estimated exposure coefficient, see Appendix B	Country - Sector	IMF, Bloomberg, authors' estimates	3.99	126.88	-833.5	577.24
Size	log USD values	Quarterly	Total assets	Country - Sector	Bloomberg	9.42	3.11	0.68	18.10
Financial constraints	index from 0-100	Quarterly	Estimate based on Whited and Wu (2006), see Appendix B	Country - Sector	Bloomberg, authors' estimates	60.83	43.22	0.09	99.57
<b>Banking policy</b>									
Debt guarantees	0-1 dummy	Weekly	Dummy=1 after announcement of policy measure	Country	BIS, CGFS database, Bloomberg	0.32	0.47	0	1
Deposit guarantees	0-1 dummy	Weekly	Dummy=1 after announcement of policy measure	Country	BIS, CGFS database, Bloomberg	0.44	0.50	0	1
Capital injections	0-1 dummy	Weekly	Dummy=1 after announcement of policy measure	Country	BIS, CGFS database, Bloomberg	0.26	0.44	0	1
<b>External exposure / segmentation</b>									
Capital flows	% of GDP	Monthly	Net sales of long-term US securities by domestic residents and of foreign securities to US residents, scaled by country GDP; a positive number means a net inflow of capital into country X from the US	Country	US Treasury International Capital (TIC) data	-1.19	9.87	-24.42	64.41
Financial integration	% of GDP	Annual	Stock of portfolio assets & liabilities with the US, scaled by GDP	Country	IMF, CPIS data	36.75	67.61	0.07	778.01
Financial depth	% of GDP	Quarterly	Equity market capitalization, scaled by GDP	Country	Bloomberg	71.86	90.59	4.60	593.90
Trade integration	% of GDP	Annual	Sum of exports and imports with the US, scaled by GDP	Country	IMF, Haver, Bloomberg	108.39	76.43	28.17	455.40
Exchange rate exposure	% of GDP	Constant	Estimated exposure coefficient, see Appendix B	Country - Sector	IMF, Bloomberg, authors' estimates	-8.42	93.56	-690.8	808.82
Difference in opinion	correlation between -1 and +1		correlation of bilateral portfolio flows with the US and equity returns		US Treasury International Capital (TIC) data, Bloomberg	0.20	0.17	-0.17	0.76
<b>Information asymmetries</b>									
Distance	in km, logs	Constant	Log distance between country X's capital city and the US	Country	A. Rose website, Daude-Fratzscher (2008)	8.56	0.39	6.98	9.15
Telephone traffic	in 1000	Constant	Volume of telephone calls traffic with the US	Country	ITU Directions of Trade	555	1178	0.00	7068
Newspaper imports	in USD million	Constant	Net imports of newspapers and periodicals from US	Country	UN Comtrade database, Exports of item 8922 SITC Rev.2	13.15	4.08	-2.16	20.15
<b>Domestic macroeconomic fundamentals</b>									
Political stability/institutions	index from 0-50	Constant	Political risk index; higher number = more risk / worse institutions (inverse of ICRG index)	Country	International Country Risk Guide (ICRG)	12.89	4.39	1	28
Sovereign rating	continuous variable, 6-22	Weekly	Rating of sovereign debt, linear transformation	Country	IMF, Haver, Bloomberg	16.29	4.75	6	22
FX reserves	% of GDP	Annual	Foreign exchange reserves, scaled by GDP	Country	IMF, Haver, Bloomberg	18.35	4.69	4.80	100.70
Current account	% of GDP	Annual	Current account balance, scaled by GDP	Country	IMF, Haver, Bloomberg	0.68	7.59	-17.11	27.98
Unemployment rate	in %	Annual	Unemployment rate	Country	IMF, Haver, Bloomberg	7.81	6.18	2.10	38.71
Government budget	% of GDP	Annual	Fiscal balance, scaled by GDP	Country	IMF, Haver, Bloomberg	-0.18	4.24	-7.80	19.61
<b>Global/common risk and liquidity</b>									
Risk - VIX	in basis points	Weekly	VIX index based on S&P500 call options	Global	Bloomberg	22.00	8.92	9.89	80.86
Credit risk - TED spread	in basis points	Weekly	US TED spread	Global	Bloomberg	52.18	44.97	0.11	463.08



# Channels of contagion – *Individual instruments*

	Contagion				Interdependence		
	US	Global	Domestic	Other	US	Global	Domestic
<b>Banking exposure</b>							
Bank exposure to US	-0.0579***	0.0172	0.0877***	0.0162	0.0191***	0.0104	0.0071
Bank exposure to ROW	-0.0070***	-0.0022	0.0081***	0.0044	0.0014*	0.0062***	0.0017**
Credit growth	-0.0058***	-0.0005	0.0017*	0.0227***	0.0029***	0.0019***	0.0015***
Interest rate exposure (firm)	-0.0339**	0.0174	-0.0600*	0.0438	-0.0808***	-0.0668***	0.1838***
Size	-0.0654	-0.1246	0.1183	0.2791	0.0392	0.0077	-0.0156
Financial constraint	-0.0138**	-0.0212**	0.0141**	-0.0068	0.0024	0.0001	-0.0006
<b>Banking policy</b>							
Debt guarantees	0.0147	-0.0144	-0.0401*	-0.0820			
Deposit guarantees	0.0141	-0.2029*	-0.0389*	-0.0831			
Capital injections	0.0239	0.0127	-0.1296***	-0.0663			
<b>External exposure / segmentation:</b>							
Portfolio investment flows	-0.0007***	-0.0004	-0.0008***	0.0007**	0.0006***	0.0010**	0.0006***
Financial integration	-0.0193***	-0.0086*	-0.0040**	0.0225***	0.0108***	0.0111***	0.0013***
Financial depth	-0.0013***	-0.0020***	-0.0012***	0.0002	0.0012***	0.0018***	0.0011***
Trade integration	-0.0038***	-0.0028	-0.0014*	-0.0061*	0.0047***	0.0047***	0.0032***
Exchange rate exposure (firm)	-0.0604***	-0.0478**	-0.1389***	0.1390***	-0.0899***	-0.0764***	-0.0871***
Difference in opinion	-0.0003	0.0001	-0.0003	-0.0023*	0.0003	0.0003	0.0006**
<b>Information asymmetries</b>							
Distance	0.0135	-0.0295	-0.0000	-0.1501***	0.0243***	0.0506***	0.1132***
Telephone traffic	-0.0000	0.0001**	-0.0000	-0.0002*	0.0000***	-0.0000**	0.0001***
Newspaper imports	0.0041	0.0153	0.0000	-0.0139	0.0658***	0.0352***	0.0079
<b>Domestic macroeconomic fundamentals:</b>							
Political stability/institutions	-0.0078***	-0.0023	0.0022	0.0667***	0.0047***	0.0030**	0.0108***
Sovereign rating	-0.0327***	-0.0097	0.0078	0.1132***	0.0130***	0.0125**	0.0385***
FX reserves	-0.0055***	-0.0131***	-0.0130***	0.0021	0.0064***	0.0105***	0.0152***
Current account position	0.0036	0.0054	-0.0056***	0.0001	-0.0030**	0.0018	0.0000
Unemployment rate	0.0264*	-0.0287	0.0560***	0.0982*	-0.0182***	-0.0166***	-0.0125***
Government budget	-0.0200***	-0.0049	-0.0154***	0.0218	0.0122***	0.0056**	0.0047***
<b>Global/common risk and liquidity:</b>							
Risk - VIX	0.0084***	0.0074***	0.0087***	-0.0050*	-0.0084***	-0.0074***	-0.0069***
Credit risk - TED spread	0.0010***	0.0017***	0.0010***	-0.0017***	-0.0008***	-0.0016***	-0.0010***



# Key results - *Interdependence*

## By region

## By sector

<b>Region</b>	<b>Interdependence</b>		
	$\beta_0^G$	$\beta_0^U$	$\beta_0^D$
Latin America	0.360 ***	0.594 ***	0.604 ***
Western Europe	0.539 ***	0.633 ***	0.512 ***
Emerging Europe	0.347 ***	0.273 ***	0.473 ***
Middle East/Africa	0.163 ***	0.084 ***	0.467 ***
Developed Asia	0.531 ***	0.494 ***	0.655 ***
Emerging Asia	0.350 ***	0.267 ***	0.679 ***

<b>Sector</b>	<b>Interdependence</b>		
	$\beta_0^G$	$\beta_0^U$	$\beta_0^D$
Basic Materials	0.446 ***	0.460 ***	0.586 ***
Communications	0.303 ***	0.448 ***	0.562 ***
Consumer, Cyclical	0.410 ***	0.416 ***	0.568 ***
Consumer, Non-cycl	0.358 ***	0.360 ***	0.492 ***
Diversified	0.471 ***	0.522 ***	0.762 ***
Energy	0.402 ***	0.393 ***	0.499 ***
Financial	0.583 ***	0.492 ***	0.476 ***
Industrial	0.421 ***	0.440 ***	0.561 ***
Technology	0.249 ***	0.679 ***	0.575 ***
Utilities	0.336 ***	0.291 ***	0.448 ***



# Key results - *Contagion*

## By region

<b>Region</b>	<b>Contagion</b>			<b>Interdependence</b>			<b>Other</b>
	$\gamma_0^G$	$\gamma_0^U$	$\gamma_0^D$	$\beta_0^G$	$\beta_0^U$	$\beta_0^D$	$\eta_0$
Latin America	0.090 ***	0.223 ***	0.212 ***	0.305 ***	0.537 ***	0.575 ***	0.091
Western Europe	0.015	0.173 ***	0.241 ***	0.509 ***	0.588 ***	0.468 ***	-0.049
Emerging Europe	0.109 ***	0.167 ***	0.318 ***	0.281 ***	0.209 ***	0.405 ***	-0.160 ***
Middle East/Africa	0.082 *	-0.038	0.337 ***	0.127 ***	0.092 ***	0.406 ***	0.171 *
Developed Asia	0.016	0.156 ***	0.194 ***	0.507 ***	0.455 ***	0.617 ***	0.005
Emerging Asia	0.089 **	-0.004	0.197 ***	0.324 ***	0.261 ***	0.639 ***	-0.036



# Key results - *Contagion*

## By sector

<b>Sector</b>	<b>Contagion</b>			<b>Interdependence</b>			<b>Other</b>
	$\gamma_0^G$	$\gamma_0^U$	$\gamma_0^D$	$\beta_0^G$	$\beta_0^U$	$\beta_0^D$	$\eta_0$
Basic Materials	0.009	0.324 ***	0.469 ***	0.391 ***	0.379 ***	0.494 ***	-0.103
Communications	0.015	-0.037	0.096 ***	0.305 ***	0.455 ***	0.539 ***	0.036
Consumer, Cyclical	0.039	0.096 ***	0.232 ***	0.379 ***	0.386 ***	0.519 ***	-0.068
Consumer, Non-cycl	-0.075 ***	0.091 ***	0.137 ***	0.366 ***	0.341 ***	0.462 ***	0.000
Diversified	0.037	0.157 *	0.163 ***	0.433 ***	0.477 ***	0.709 ***	-0.045
Energy	0.103 **	0.286 ***	0.401 ***	0.336 ***	0.320 ***	0.433 ***	0.172 ***
Financial	0.203 ***	0.106 ***	0.194 ***	0.495 ***	0.441 ***	0.439 ***	-0.217 ***
Industrial	0.033	0.196 ***	0.335 ***	0.379 ***	0.383 ***	0.498 ***	-0.148 *
Technology	0.192 ***	-0.157 **	0.083	0.217 ***	0.704 ***	0.574 ***	-0.105
Utilities	0.068	0.179 ***	0.310 ***	0.286 ***	0.236 ***	0.394 ***	0.172 ***



# Exchange & interest rate exposure

$$R_{i,t} = \delta_0 + \delta_i \Delta s_{i,t} + \kappa_i R_t^{US} + e_{i,t}$$

$$R_{i,t} = \eta_0 + \eta_i \Delta r_{i,t} + \kappa_i R_t^{US} + e_{i,t}$$

- $R_{i,t}$ : return of country-sector portfolio  $i$  on date  $t$
- $R_t^{US}$ : return of US stock market on date  $t$
- $S_{i,t}$ : bilateral exchange rate change vs. USD on date  $t$
- $r_{i,t}$ : change in domestic 3-month interest rate on date  $t$
- Estimated prior to crisis

*(Dominguez and Tesar, 2001 & 2006; Amer et al. 2009)*



# Financial constraints at the firm level

$$FC_{i,t} = -0.09 CF_{i,t} - 0.062 DD_{i,t} + 0.02 DA_{i,t} \\ - 0.044 \ln A_{i,t} + 0.10 IG_{i,t} - 0.035 FG_{i,t}$$

*CF* = cash flow-net asset ratio

*DD* = firm's dividend payments

*DA* = debt-net assets ratio

*A* = total net assets

*IG* = industry growth rate

*FG* = firm's growth rate in net assets

*(Whited and Wu 2006)*